Will an autonomous surgical robot be able to replace a Consultant General Surgeon in theatre within 10 years? A literature review

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Background: Artificial Intelligence is being integrated into surgical robots. This raises the possibility that a truly autonomous surgical robot could perform those tasks undertaken by a Consultant surgeon in the future.

Aim: To assess whether such a robot exists in any guise now and if so, whether it seems reasonable that these robots will routinely be in theatre within 10 years.

Method: Literature review of PubMed and the top three global internet search engines.

Results: A robot has completed a surgical task which demonstrates "supervised autonomy". The Smart Tissue Autonomous Robot (STAR) completed a small bowel anastomosis *in vivo* on an anaesthetised pig in 2016. No complications were reported.

Discussion: There is no credible evidence that these robots will be in regular or routine use within 10 years. Current barriers include significant further technical development requirements, patient and surgeon acceptance of wholly autonomous robotic surgery, complex medico-legal issues, and appropriate funding models.
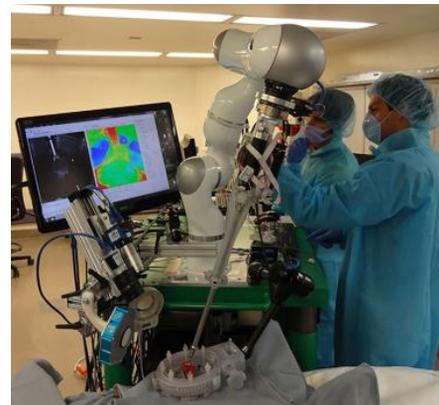
Supervised autonomous robotic soft tissue surgery
Azad Shademan, Ryan S. Decker, Justin D. Opfermann, Simon Leonard, Axel Krieger and Peter C. W. Kim
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What did the STAR robot achieve? *Ex vivo* and *in vivo*, the STAR managed to fashion a small bowel anastomosis on pig intestine, without human intervention. The tissues had been marked with near-infrared fluorescent tags [NIRF] by humans so that the robot could identify bowel with its imaging system.
- STAR was coded with the "the best" techniques for this type of join based on consensus and the physics of tissue manipulation relevant to the task
- Its own algorithm decided where and when to pick up and place the sutures with an articulated arm to 7 degrees of freedom
- STAR took significantly longer to complete the task as compared to an experienced surgeon (50 vs 8 minutes)
- The research team felt that the sutures were , on average, more evenly spaced and the gut less "leaky" than the human anastomosis
- In 2017, STAR has gone on to demonstrate that it can make more precise incisions and in consequence cause less damage to surrounding tissues than those made by human hands